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TO: Perry Miller, Capt., AUS

FROM: Isaiah Frank

SUBJECT: German Imported Key Materials

INTRODUCTION

Coverage of Report

Attached is a report detailing sources, transport routes, and the supply situation of nineteen key raw materials and components imported into the central German area.

The report covers for each item all known significant sources outside of Germany, Austria and Czechoslovakia, location of the plants, ownership or management of firms, and estimates of the relative importance of the contribution of each plant. Disposition of the material after it leaves its source and transport routes used are given in so far as they are known or can be inferred. Distinctive features of the production process and their vulnerability are pointed out and a statement is included evaluating the tightness of supplies of the commodity in the German war economy.

Priorities

To facilitate use of this information by the Planning Staffs of R & D and SO, priorities have been assigned to all items in the report on a 1-2-3 scale. The materials rating highest as targets are given "1" priorities; "3" priorities are for those rating lowest.

	A Priority With Respect to Effect of Given Percentage Loss of Output	B Priority With Respect to Portion of Total Output That Can Be Affected
Aero-tires	1	2
Aero-engines	1	3
Airframes	1	2
Alumina	2	2
Anti-friction Bearings	1	1
Antimony	2	1
Bauxite	3	2
Chrome	2	1
Cobalt	2	1
Copper	2	1
Fuel Injection Pumps	1	2
Magnesium	3	1
Manganese	2	2
Molybdenum	2	1
Nickel	2	1
Petroleum	1	2
Radio Tube Hard Metal Components	2	1
Synthetic Rubber	2	2
Tungsten	2	3

The table on the preceding page gives two priority ratings for each commodity. The rating in Column A refers to the item's priority with respect to the effect of a fixed percentage loss of output (say 5 percent) on Germany's fighting capabilities. Column A therefore takes into account such factors as: the "depth" of the material -- i.e., the length of time between the loss of output and the effect on front line strength; the ratio of current output to stocks; the cushion in the form of low priority uses of the commodity which might be sacrificed in an emergency; the possibility of using substitutes. The rating in Column A, therefore, may be considered as a summary designation of the bearing of all these factors on the target potentiality of the material. In brief, it denotes the item's "strategic priority".

The number in Column B may be regarded as indicating the "vulnerability priority" of the commodity. It summarizes for each commodity the factors bearing on the proportion of its total output that can be affected by Special Operations. Specifically, the factors taken into account in assigning the rating in Column B are: percentage of total output in operations area; concentration of output in operations area; existence of excess capacity or alternative processing equipment; technical nature of plant process; accessibility factors; and replacement time.

Separation of the two sets of factors summarized in Columns A and B should make possible a greater degree of flexibility in the uses to which the report is put. For example, operational considera-

tions may dictate the advisability of choosing a target because of the concentration of a large output in the operations area and the ready availability of sabotage techniques. Magnesium might under these circumstances fill the bill even though its strategic priority rating is only "3". On the other hand, it may be decided to ignore considerations of plant concentration and availability of highly developed sabotage techniques in order to destroy something which would affect front-line Axis military strength rather promptly. Under such circumstances, aero-engine plants might recommend themselves as targets even though their vulnerability rating is as low as "3".

Further Details

We are accompanying this report with a copy of the "Implementation Study for Peripheral Areas" prepared by the Operations Section of R & A. For most of the items included in the attached report further details may be obtained in the Implementation Study on uses, supplies, substitutes, process and layout information. Implementation studies are in process for most of the remaining items not included in the accompanying study. One or two of them, however, will not be included at all for special reasons -- e.g., tungsten, since all significant sources are in neutral countries and operations can be conducted only on material in transit.

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AERO-TIRES

Sources

Country	Location	Firm	Remarks
France	Montlucon	S.A. des Pneumatiques Dunlop	Capacity substantial but probably not working at present
	Clermont-Ferrand	Michelin et Cie	Capacity very large but probably not now producing
Italy	Milan Turin	Pirelli) SPIGA)	8% of total in Axis Europe
Rumania	Floresti	Banloc	Small
Poland	Dembica	Stomil	Small

Transport

In case of French plants there are unconfirmed reports that facilities are being dismantled and shipped eastward by rail. Italian production is probably used for the most part for replacements in the Italian theatre, though some rail shipments to Germany undoubtedly take place. The small Rumanian and Polish production is probably sent by rail to the new final aircraft assembly plants in the East.

Processes

Building machines, drums, and calenders constitute most difficult parts of aero-tire plants to replace.

Supply Situation

Appreciable stocks do not exist in Germany. Rapid deterioration of aero-tires on operational aircraft together with air attacks on the largest German plants have led to a fairly tight situation.

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AIRCRAFT ENGINES

Sources

Country	Location	Firm	Remarks
Hungary	Budapest (Csepel Island)	Manfred Weiss	It has recently been producing DB 605's for Messerschmitt planes. Output reported, 120 engines per month.
Yugoslavia	Maribor	Steyrwerk Maribor	Has produced DB components but may at present be inactive
France	Paris (Blvd. Kellermann) Limoges Arnage (Le Mans) Paris (Issy-les-Moulineux)	Gnome & Rhone	Produces G & R and BMW 132 engines and components for same. These engines are just under 1,000 hp. Are used in special types of operational planes.
	Strasbourg	Junkers	Repairs Jumo engines.
	Woippy (Metz)	Hobus Werke	Type of aircraft engine it produces as yet unconfirmed

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Transport

The engines produced at Manfred Weiss are probably incorporated in planes assembled at the Donau Flugzeugbau plant in the Budapest area. The components produced at the Maribor plant in Yugoslavia are probably incorporated in DB engines produced by Flugmotoren Ostmark at Graz and at Wiener Neudorf in Austria. Most of the engines produced in France go to Germany for final assembly.

AIRCRAFT ENGINES (Cont'd)

Processes

Machine shops in engine plants should be considered as possible targets since they have numerous machine tools and special jigs for holding work during the machining process. Engine testing beds should also be considered since they contain delicate testing instruments difficult to replace.

Supply Situation

Tight. Not only must aero-engine output keep pace with new aircraft production but the existing air forces must be sustained with frequent engine replacements.

AIRFRAME AND AIRFRAME COMPONENT ASSEMBLY

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Sources

Country	Location	Firm	Remarks
Poland	Posen	Focke-Wulf	Over 100 sets of components per month. May be turning to production of complete FW 190's. Will contribute 3-5% of German S/E fighter production.
	Krzesinki	Focke-Wulf	110-125 FW 190's per month. Thought to be taking over Marienburg plant production. 10%+ of German S/E fighter production. Importance increases in ratio to bombing raids on Germany.
Hungary	Csepel Island (Budapest)	Donau Flugzeugbau	The Duna plant accounts for 5-10% of fighter production. Emphasis has been on T/E production (ME 210's). Now produces some S/E fighters (ME 109's).
Yugoslavia	Zemun	Messerschmitt	Present emphasis on repairing planes from Russian front. Produces some ME components. Of decreasing importance due to guerilla warfare. Production small.
France	Paris	Junkers (Amiot)	Produces 20 JU 52 transports per month; 2.5% of the transport-trainer-reconnaissance category. May also build components to be sent to Germany. Of small importance -- will be less so.
	Villacoublay	Morani Saulnier	Produces 25 light transport (or trainers ?) per month; 3% of transport-trainer-reconnaissance category. May also build components to be sent to Germany. Of no great importance.

Sources

Country	Location	Firm	Remarks
France	Bordeaux	SNCASO	Thought to be producing 35 FW 189's (army cooperation planes) per month. May also build components to be sent to Germany. Output may be less. Probably not more than 5% of transport-trainer-reconnaissance category. Present importance not great.

Transport

The Posen, Krzesinki, and Csepel Island plants make most of their own components. The finished product is probably subject to fly-away delivery. Engines for the FW 190's are BMW's built at Munich, Eisenach, Basdorf, and Hamburg. It is impossible to say which of these plants serve the two Polish assembly plants listed above. The Csepel Island assembly plant receives its engines from the engine factory on the northern side of the same island. The source of the components and engines delivered to the Zemun plant is unknown, though some components may be manufactured at the plant itself.

The French plants probably produce their own planes for fly-away delivery, plus some components sent to Germany. Components from the Junkers-Amiot plant may be sent by rail to Dessau and Bernberg. Components from the Bordeaux plants may be sent by rail to FW plants in Northern and Eastern Germany and Poland. Engines for the Junkers-Amiot planes may come from Magdeburg or Strassburg or one of the other Junkers engine plants. Engines for the Bordeaux FW planes come from Germany, but the exact plant or plants are unknown.

Processes

Damage to pressing and component erection shops will do the greatest injury to an airframe plant. Presses are heavy complex machines, vital to the process, custom-built, and could only be replaced in the space of months. Stretching machines are inverted presses to which, though they are lighter built than regular presses, the same remarks apply. In the component erection shops the finely designed jigs and the tool and design shop would also be worthwhile objectives.

Supply Situation

Axis plane production in general is tight. Most necessary and most deficient in supply is the single-engine fighter. Up to the first of October production kept barely ahead of losses, squadron strength at the front had taken a sharp drop since July 1, and commitments were constantly increasing. Since the first of October production may even have fallen temporarily behind losses.

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ALUMINA

Sources

Country	Location	Firm	Remarks
Norway	Hoyanger	Norsk Aluminum Kontor	Probably producing 10,000 tons per year
	Sandasjoen	Norsk Aluminum Kontor	Not now known whether producing. Plant expected to be finished sometime this year.
	Heroya	Norsk Hydro (I.G. Farben)	Capacity: 10,000 tons
Italy	Porto Maghera	SAVA	Capacity: 60,000 tons
	Porto Maghera	Montecatini	Capacity: 75,000 tons
	Aurelia	Neuhausen (Swiss firm)	Capacity: 6,000 tons
France	St. Auban	Alais Froges et Camargue	Capacity: 50,000 tons
	La Barasse	Soc. Electro-Chemie	Capacity: 20,000 tons
	Gardanne	A.F.C.	Capacity: 60,000 tons
	St. Louis-les Aygalades	A.T.A.G.	Capacity: 30,000 tons
	Salindres	A.F.C.	Capacity: 30,000 tons
	Villeveyrac		Capacity: 25,000 tons
Yugoslavia	Moste	Vereinigte Aluminum Werke (through Guilini)	Capacity: 7,000 tons
	Lozobac	Fabrika Aluminiya (under Italian control now)	Capacity: 3,000 tons

ALUMINA (Cont'd)

Sources

Country	Location	Firm	Remarks
Hungary	Magyarovak	Bauxit Ipar R.T.	Capacity: 10,000 tons
	Dunaalmus-Tuzito	Danauteler Alaunerde Industrie	Capacity: 60,000 tons

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Transport

Norwegian alumina is reduced locally to aluminum. Little transportation is involved. In Italy alumina is reduced in the electrolytic plants at Porto Maghera, Mori, and Bolzano. Short rail hauls are involved. Similarly a greater part of French alumina is used in local reduction plants. The balance is shipped by rail to Switzerland where it is converted into aluminum. The finished French aluminum is shipped to alloying, casting and forging plants both in France and in Germany for use chiefly in aircraft. The small Yugoslavian and Hungarian outputs are principally for local consumption. Some alumina from Hungary in excess of local needs is shipped to Germany chiefly by the Danube.

Processes

The Bayer process is most commonly used. The Hoyanger and Sandasjoen plants in Norway use the Pedersen process; the Heroya plant in Norway employs the Goldschmidt process based on labradorite.

Supply Situation

The general alumina situation is tight although not critical. Within Greater Germany proper there is a rough balance between the output of alumina and aluminum. Some shipment, however, takes place in reverse -- i.e., Germany supplies the Norwegian aluminum plants with about 60,000 tons of alumina each year. Shipment is of course via the Skagerrak and by rail.

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ANTI-FRICTION BEARINGS

Sources

Country	Location	Firm	Remarks
France	Bois-Colombe, Paris	C.A.M.	5% of total European output
	Ivry-Port, Paris	C.A.M.	5% of total European output
	Annecy	S.R.O.	5% of total European output
	Aubervilliers, Paris	Malicet et Blin	2.5% of total European output
	Asmieres	Timken	2.5% of total European output
Italy	Villar Perosa Turin	R.I.V.) R.I.V.)	15% of total European output. Both these plants have been severely damaged by air attacks within the past week (Nov. 4-10).

Transport

The tonnage of bearings produced by all plants in the peripheral areas does not represent a substantial item from the point of view of transport. Until recently Italian ball bearings were used largely as components by the Fiat complex in Turin. During the last few weeks, however, ball bearings from the Italian plants undoubtedly have been shipped via Alpine rail routes to Germany in order to supplement the reduced production there consequent upon the Schweinfurt raid. A good part of the French output is used to supply the French automotive and aircraft industries now working for the Germans. The balance is shipped by rail to German factories.

ANTI-FRICTION BEARINGS (Cont'd)

Processes

Note: The machine tools used in the industry, especially the grinding machines, are of the highest precision and can be damaged by blast or fire.

Supply Situation

As a result of the heavy bombing of the main production center in Europe, namely Schweinfurt, and the recent bombing of the Turin and Villar Perosa plants, it may be presumed that a position of great stringency exists in Germany.

ANTIMONY SECRET

Sources

Country	Location	Firm	Remarks
Yugoslavia	Brzitsa (Stolica mine)	Podrinje Consolidated Mines, Ltd.	The Stolica mine is the most productive antimony mine in Yugoslavia (50% of Yugoslavian output). Worked on four levels, has a deep shaft. Ore of 20% content. Has a smelter of 1000 tons capacity.
	Near Krupanj	Lissa Mining Co. (?)	Second in importance to Stolica. Is reported to have a new smelter of unknown capacity.
	Near Krupanj (Zajaca mine)	Montania Mining Co. (?)	Has primitive smelter, 750 tons capacity

Other scattered Yugoslavian antimony mines are too small to be listed, but most of them are in the neighborhood of Krupanj.

Hungary	Felsö banja Bulza Bosing Near Mezibrodden Allehota	These are all small mines; details on ownership and layout are lacking.

(Though it is not one of the peripheral countries, it is worth noting that Czechoslovakia is almost as important a producer of antimony as Yugoslavia. -- See section on "Supply Situation" below.)

Rumania, Greece, France, and Turkey also have small deposits of antimony, but these are not only unimportant, but at present are supplying the Germans with little or no ore.

Italy is the only considerable producer beside Yugoslavia, Czechoslovakia, and Hungary. Some of its major deposits are in Sardinia but the mines in Northern Italy are, of course, still in Axis hands. They are located in:

Italy	Chiusdino Vallerano Alto Adige district (Bolzano Province)

Transport

The exact routes followed are unknown, but it seems probable that in every case the ore goes by rail to Germany. The total amounts of ore are small and it should not be difficult to transport them even where the transportation system is used to the limit.

Processes

Most of these mines are underground. Details of layout are unknown except in the case of the Stolica mine which is known to have a deep shaft, to be worked from four levels, and to require pumping at the lower levels. The smelters listed are reported to be small

Supply Situation

Approximately 35-40% of Germany's antimony supply comes from Yugoslavia and an equal amount from Czechoslovakia and Hungary together. As noted above, the only other considerable source would be Italy, but a larger share of Italian production is now in Allied hands and the rest is endangered. Even if it is assumed that the latter remains in Axis hands for some time longer, Germany will have a surplus of only slightly more than 250 tons for this year.

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BAUXITE

Sources

Country	Location	Firm	Remarks
Hungary	Gant	Owned by Bauxite Trust and worked by several German and Hungarian subsidiaries (names available)	Largest producing deposit in Europe
	Halimba	Aluminumerz Bergbau und Industrie A.G.) Ungarische Bauxit- gruben A.G.)	Large producing area
France	Brignoles & Lalue in the department of Var	Before the war the mines were operated principally by subsidiaries of Neuhausen (Swiss), Aluminum Ltd. (Canadian), Norsk Aluminum Co. (Norwegian) and Pechiney (French). Changes in ownership and control since the war are not clearly known. It is reported that Hansa Leichtmetall A.G., Bauxite Trust A.G., and I.G. Farben are interested in these properties.	This deposit produces the bulk of French bauxite
	Villeveyrac in the department of Herault		Produced approximately 100,000 tons or 1/6 of output of Var
	Bouches du Rhone and Ariege departments		Relatively small producer
Italy	Istrian Peninsula Central part near Brije, Visenda, Pisina Southern part near Havorigo, Altura, Sissano	Societa Anomina Mineraria Triestina Societa Anomina per l'Escaro el'Industria di Minerali d'Allumino Bauxite Istriane Soc.	For the whole Istrian Peninsula output is probably around 400,000 tons
Yugoslavia	Principal deposits are near Mostar and Drnis	Kontinentalno Boksitno controlled by the Bauxite Trust Jugoslavanski Bauksit controlled by Bauxite Trust A.G. Adria Bauksit	Yugoslavia has produced in the past well over 100,000 tons per year. Present output is much smaller due to guerilla interference with both mining and transportation.

BAUXITE (Cont'd)

Sources

Country	Location	Firm	Remarks
Greece	Parnassus) Eleusis) Elippulos)	Probably operated by Leichtmetall Company	Output much diminished over pre-war due to labor and transport problems.

Transport

The bulk of Hungarian ore is shipped to plants in Germany via the Danube and by rail. Italian ore is used principally in Northern Italian alumina plants although some is shipped via the Villach-Tarvisio rail line to Germany. Somewhat more than half the French ore is processed within the country, the rest exported by rail to Germany. The Greek and Yugoslavian ore has hitherto relied heavily on relatively short rail hauls to nearby ports and then water-shipment to Trieste. It is doubtful if this route can now be safely used.

Processes

Virtually the entire output of bauxite is obtained by open-pit mining methods. Some sabotage possibilities exist in the form of interfering with mechanical digging equipment.

Supply Situation

Tight but not critical.

Sources

Country	Location	Firm	Remarks
Yugoslavia	Radusa (Nada mine)	Allatini Mines Ltd.	Underground mine; a wet mine, though shallow. Concentration plant with a capacity of 100 tons daily. One of three mines producing bulk of Yugoslavian chrome.
	Orasje	Allatini Mines Ltd.	An "upper" and a "lower" mine. Considered as one mine. One of three mines producing bulk of Yugoslavian chrome.
	On Shar Mountain (near Urosevac)	Asseo Corp.	Open pit and underground workings. Production by primitive methods. Ceases in winter. Next in importance to two Allatini mines, however.

Greece formerly produced an important amount of chrome, but production has recently been eliminated through guerilla action. It seems unlikely that the Germans will be able to return them to production during the period of the war. Greek mines are therefore not listed.

Other Axis sources are unimportant save for Turkey.

Transport

Ore from the Ljuboten region (Allatini and Asseo mines) of Yugoslavia is shipped by the standard gauge single-track railway running between Skoplje and Belgrade. From here it is sent to Germany probably by rail.

Processes

When concentration takes place near the mine and smelting and refining are done at some distance, the concentrator is a worthwhile

Processes (Cont'd)

target. An operation in the production of ferrochromium which is especially vulnerable is the making of low carbon alloys. They are made by refining high-carbon ferrochromium with an oxidizing slag of chromite to remove the carbon. This operation must be conducted with great care and under close control (usually in an electric furnace) or the chromium will become oxidized, enter the slag, and be lost.

Supply Situation

Axis consumption of chrome for 1943 promises to have exceeded available new supplies and reserves are at a very low point. This is due to the knocking out of the Greek mines and partly to the failure of Turkey to deliver more than a quarter of the 90,000 tons she agreed to send Germany under the Clodius agreement. Yugoslavian chrome will constitute about 45% of Axis new chrome for 1943.

COBALT SECRET

Sources

Country	Location	Firm	Remarks
Finland	Outokumpu (Vuoksennisha)	"Outokumpu"	Produces 67% of German production. Mine near Russian front. This mine primarily a copper mine. Both copper and cobalt processed at Imatra, 100 miles to south. Imatra was electric smelter. Ore concentrated at Outokumpu.

Rest of Axis European production in Germany.

Transport

Outokumpu is located about 200 rail miles north of Vïpuri. It is not far from the Karelian frontier. Original rail outlet was through Russian territory. In 1940, a rail line through Finnish territory was being constructed to Varkaus and is likely to be completed. From here ore probably goes by rail to Helsinki from whence it is carried by boat via the Baltic Sea to Germany.

Processes

The ore is usually smelted in a blast furnace to form a slag and speiss. This speiss is then roasted to remove the bulk of the arsenic which is saved as a by-product, and the residue is treated by various wet methods to recover the valuable elements. The final step is to reduce cobalt oxide to metal by heating in an electric furnace with charcoal, coke, and limestone, thus forming the metal and a fusible slag.

Supply Situation

Current supplies of new cobalt, now wholly dependent on the resources of Germany and Finland, are far short of demand, even though demand has been ruthlessly controlled. However, of the three fields in which cobalt is mainly used (alloys, pigments, and in the making of synthetic oil) one has a surplus stock of the material sufficient to allow consumption to continue in all three fields at a relatively high level for some time. The surplus stock referred to is in the synthetic oil field (FischerOTropsch method) where carbonyl iron powder has been successfully substituted for cobalt as a catalyst.

COPPER SECRET

Sources

Country	Location	Firm	Remarks
Yugoslavia	Bor	Mines de Bor	Mine produces 40% of German copper supply. An underground mine with two shafts (one transport, one ventilating). Largest single producer of copper ore in Europe. Bulk of product blister copper, smelted in own furnace smelter. Also has small electrolytic refinery, processing 20% or less of output. Plant damaged in 1941 by Yugoslavs, restored by Germans. May not be in full production.
Finland	Outokumpu	Outokumpu Co. (?), Imatra, Finland	Mine produces 10% of German copper supply. There is an electric smelter of 14,000 tons capacity at Imatra. An underground mine with two shafts. Ore is concentrated at the mine.
Norway	Roros Lokken Orkla Sulitjelma	? ? Norwegian Fearuley Financial Group	The Roros mine produces less than 1% of Axis copper; Lokken Orkla, 2%; the Sulitjelma complex, 9%. The Sulitjelma group of seven mines has a flotation plant, 2 smelters (one electric) and a refinery. Power for Sulitjelma mines is from Fagerli and Gjertrudammen power stations. Vulnerable point of whole Sulitjelma complex. All three groups of mines produce blister copper for Germany.

Transport

Blister copper from Bor is transported by rail to the Danube at Prahovo, by truck to the Danube at Donji Milanovak, by rail to Belgrade via Paracin, from where it may go either by rail or via the Danube to Germany and Belgium. The large Hoboken electrolytic refinery at Oolen, Holland, and the Norddeutsche and Zinnwerke electrolytic refineries in Hamburg may process Bor ore in its advanced stages of refining. (The Norddeutsche refinery was but slightly damaged and the Zinnwerke refinery was undamaged in the series of raids on Hamburg from the end of July into early August.)

Copper concentrates are received at the Imatra electric smelter from the concentrator at Outokumpu. From Imatra blister copper goes to Helsinki, whence it is shipped by boat to Germany, very likely to Hamburg.

Blister copper is shipped from the Sulitjelma mines by a 15-mile narrow-gauge railway to Sjonsta from whence it is barged to Finneid and moved by aerial tramway across a narrow isthmus to tidewater, also possible from Sandnes concentrator and smelter by narrow-gauge railway to main Nordland railway, connecting with ports on Skagerrak.

Processes

Mine installations, damage to which would seriously interfere with mining operations, are discussed in the Bor mine report.

In electrolytic refineries the most vulnerable parts are the reverberatory furnaces and the tank houses, though power is most fundamental if there are no alternative sources in case of damage.

Processes (Cont'd)

In furnace refineries, convertors, matte furnaces, and concentrators are outstanding targets in that order. The only exception to this general rule is where a refinery produces only blister copper or an earlier stage. Here concentrators are most vital. As with electrolytic refining, power is also fundamental.

Supply Situation

Situation still tight but the now general use of steel instead of brass for cartridge cases has removed copper from the critical list (See Bor report).

One modification, however, is pertinent. Germany's copper reserve may begin to drop sharply before mid-1944 due to the fact that scrap which she formerly retrieved from the battlefield when victorious is now denied her in retreat.

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FUEL INJECTION PUMPS

Sources

Country	Location	Firm	Remarks
France	St. Ouen (near Paris)	Ateliers de Construction Lavelette (subsidiary of Rob't Bosch)	Very important producer
Poland	Czechowice (near Warsaw)	Panstwowa Zaklady Inzyneizi	A substantial producer
Italy	Sesto San Giovani (near Milan)	Fabrica Italiana Magneti Marelli	Information lacking as to whether plant is working.

Transport

The output of these plants is sent by rail to aircraft producers and also to tank and truck plants and possibly submarine yards.

Processes

Manufacture requires special process machine tools operating to extremely fine tolerances.

Supply Situation

It is doubtful if any substantial inventory exists due to expanding military demands and high wastage rates of aircraft, submarines and other military equipment.

SECRET

MAGNESIUM

Sources

Country	Location	Firm	Remarks
France	Lannemezan (Landes)	Electrochemie, Electrometallurgie et Acieries electriques d'Ugine	Capacity: 3400 tons
	Jarrie (near Grenoble, Isere)	Electrochemie, Electrometallurgie et Acieries electriques d'Ugine	Capacity: 3400 tons
	St. Auban d'Oze (near Veynes, Hautes Alpes)	Alais, Froges et Camargue	Capacity: 2200 tons
	Moissac (Var)	S. Astral	Capacity: 300 tons by electrothermic method
	Salins de Giraud (Bouches du Rhone)	Alais, Froges et Camargue	Never in production
	Le Villard du Planay (near Bozel, Savoie)	S. Bozel-Maletra	Has not produced since 1941
	Bagnols sur Ceze	S. Bozel-Maletra	Has not produced since 1941
Italy	Bolzano	S.A.I.	Capacity: 2400 tons
	Bolzano	Montecatini	Capacity: 1200 tons
	Massa	Montecatini	Capacity: 3000 tons
	Aosta	S.N. Cogne	Capacity: 3000 tons
Norway	Heroya	Norsk Hydro	Capacity prior to the recent AAF raid was in the neighborhood of 10,000 tons

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MAGNESIUM (Cont'd)

Transport

The magnesium is hauled from the plants to processors by rail. The quantities involved, considering the number of alternative routes available, do not represent a major transport problem.

Processes

All but the small Moissac plant in France use some variation of the electrolytic process.

Supply Situation

Not tight. Output within Greater Germany probably sufficient for most essential uses.

SECRET

MANGANESE

Sources

Country	Location	Firm	Remarks
Italy	East of Genoa (Tre Monti & Gambatista mines) Near Pisa (Cornnetto mine) Tuscany (Marte Argentarice mine) Piedmont (Mount Alpi & Mount Pu mines)	Societa Ilva	Output around 45,000 tons of 50% equivalent manganese ore
Bulgaria	Pozharova-Kostinbrod (25 km. west of Sofia) Bela (20 miles south of Varna)		Output around 13,500 tons of 50% equivalent manganese ore
Rumania	Bukovina (Terezia mine)	Greek Orthodox Church	Output around 45,000 tons of 50% equivalent manganese ore
Yugoslavia	Stikova & Jasnova (30-35 miles south of Uzice)		Output around 15,000 tons of 50% equivalent manganese ore
Hungary	Urkut (south end of Bakony Forest, west of Lake Balaton)	Deutsche Bank	Output around 24,000 tons of 50% equivalent manganese ore

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Transport

The Italian output is shipped by rail to the north Italian steel works at Milan, Turin and Genoa. Bulgarian manganese goes principally to the Ruhr. Rumanian output is shipped mainly to Resitza Iron and Steel Works within the country; small surpluses probably to Germany, shipment by rail. The Yugoslavian ore is transported by trucks to the rail station at Uzine. A small amount is shipped to smelters at Zenica

MANGANESE (Cont'd)

and Jesenici; the bulk, however, goes to the Ruhr. Most of the Hungarian ore is used in the steel works at Ozd, 120 km. northeast of Budapest. A small surplus is exported to Upper Silesia.

Processes

It is believed that facilities for the smelting of manganese ore exists at all the larger blast furnaces in Europe.

Supply Situation

Germany may have built up some stockpiles as a result of exploitation of the Nikopol mines in Occupied Russia until very recently. The mines are now within range of heavy artillery from the Russian lines. Thus the importance of the manganese mines listed above is enhanced. In an emergency, however, Germany may be able to use low grade manganiferous ore available locally.

Sources

Country	Location	Firm	Remarks
Norway	District of Flekkefjord	(The Knaben Mine)	Produces 80% of Norway's output, 70% of Axis', of molybdenum. Mine was bombed March 1943 - concentrator destroyed (reducing output 25-50%). Mine hoist and compressor house vulnerable. Power supplied by Fjotland power station and by a power line from Skjerka. Apparently no reserve of power.
	Laksadalen	(3 mines, ownership unknown)	Produce about 10% of Norway's, 8% of Axis', output of molybdenum.
	Haugesund - Telemarken-Flekkefjord triangle	?	Many smaller molybdenum mines, together accounting for 10% of Norway's output.
Rumania	Magyag (Transylvania)	?	Produces about 8% of Axis molybdenum

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Transport

Ore is trucked from the Knaben mine to Flekkefjord or to Kristiansand, or both. There is a road to each. The only road directly at the mine crosses the Kvina River over a new bridge east of Risnes and leads to that town. From there the road runs to Netland and Kvinesland (Liknes).

Supply Situation

Molybdenum is tight and supply situation is fast becoming critical. The annual molybdenum supplies of Continental Europe declined by 40%

Supply Situation (Cont'd)

from 1938 to 1942, while requirements increased by a like amount. The Germans anticipated this situation by building a huge stockpile, but that is now thought to be practically exhausted. New sources are not known to have been developed. The single greatest source, the Knaben mine, was badly damaged by bombing in March, 1943. For months it has probably been producing less than 75% of the previous output.

NICKEL SECRET

Sources

Country	Location	Firm	Remarks
Finland	Petsamo (Kolosjoki)	I.G. Farben Industrie (formerly the mine belonged to the Mond Nickel Co., Ltd.	2/3+ of Axis new nickel. (at least 4,500 tons, probably more, of contained nickel)
Norway	Near Kristiansand (at Evje, Hosanger, and Flaat.)	?	Total production of these small mines, 1000 tons or less contained nickel.
Greece	Lokris (40 mi. n.w. of Athens)	?	In early 1943 was producing 1500 tons of contained nickel. Now little or none.

Transport

Part of the product of the Petsamo mine and smelter may be shipped by truck across Northern Finland and Norway to the Arctic Sea ports of Lünahamari (Finland) and Kirkeues (Norway) but it is likely that this bulk of it is sent to Finnish ports at the head of the Gulf of Bothnia whence it goes to Germany by boat.

The output of the Norwegian mines is shipped by boat from Kristiansand across the Skagerrak to Germany.

Greek nickel goes via rail and the Danube to Germany.

Processes

Power for the Petsamo mines is derived from the Janiskovski plant, 40 miles distant. Probably no alternative power supply. Smelter at mine may smelt total output into matte.

Processes (Cont'd)

Ore from the mines near Kristiansand is processed at the Kristiansand smelter where there is considerable excess capacity.

There is no smelter at Lokris.

Supply Situation

Exceedingly tight. Despite effort to increase output at Petsamo, European mine output is not much more than 7,000 tons whereas requirements are 13,000 tons. As a result, Germany has been forced to draw on her only remaining stocks in the form of coins and civilian goods. Interruption of Norwegian and Greek output would hasten depletion of stocks. Loss of Petsamo would be disastrous for German nickel supply. Also, any interruption of supplies of chrome would adversely affect nickel position because of the mutual substitutability of these ferro alloys in many uses.

SECRET

PETROLEUM

Sources

Country	Location	Firm	Remarks
Rumania	About 15 fields, the larger ones in the Ploesti area	Formerly, chiefly British, American, French, and Dutch companies. Exact nature of present management and extent to which Germans have taken over is unknown.	Output 5,000,000 tons per year
Hungary	Budafapuszta field in extreme western tip of Hungary near the Yugoslav frontier	Was formerly owned and operated by Standard of New Jersey. Now state operated	Combined output of 3 fields 800,000 tons in 1943. Budafapuszta by far largest of the 3.
	Lovaszi field in extreme western tip of Hungary near the Yugoslav frontier	Wintershall - German group with Hungarian participation	
	Bukkszic, east of Danube	State owned	
Poland	Jaslow field Drohobycz field Stanislawov field	Owned and operated by German monopoly	Total output about 400,000 tons; 60% from Jaslow; 30% from Drohobycz; 10% from Stanislawov

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Transport and Disposition

Rumania. All Rumanian crude is refined within the country in twelve major refineries also located around Ploesti and connected with the fields by pipelines. Refineries are operated by the same companies that operate the fields.

Of the refined petroleum products 2,000,000 tons are accounted for by domestic consumption and refinery losses. One million tons go directly to the eastern front via rail tank car. For this purpose the

main line leading northeast from Ploesti is of major inportance. The remaining 2,000,000 tons go in part to the eastern Mediterranean via rail and Black Sea but mostly to Germany. Of the quantity shipped to Germany at least 1,000,000 tons are sent via the Danube.

Hungary. Half the Hungarian crude, or about 400,000 tons, is refined in the refineries situated chiefly around Budapest and connected with the fields in the southwestern part of the country by pipelines. The refined products, except for a small portion, are consumed within the country. The remaining 400,000 tons of crude are shipped chiefly by rail to refineries in Austria and Czechoslovakia.

Poland. All Polish crude is refined in plants situated near the fields and connected with the fields by pipeline. There are nine operating refineries with a capacity considerably in excess of the output of Polish fields. All are at present operated by the German monopoly.

Of the 400,000 tons of petroleum products produced about 100,000 tons are consumed in Poland and the rest exported to the eastern front by rail.

Supply Situation

Tight. Natural oil supplies are supplemented by considerable synthetic output within Germany. Any major interruption of the flow would have a direct effect on German capabilities.

SECRET

RADIO TUBE HARD METAL COMPONENTS

Sources

Country	Location	Firm	Remarks
Netherlands	Eindhoven	Phillips	Capacity for tungsten and molybdenum components of electronic tubes amounts to 20-30% of total in Europe
	Nijmegan	Vereengte Draadfabriken	Capacity about 5-10% of European total
Hungary	Upjest (Budapest)	Tungsram	Capacity 10-15% of total in Europe
France	Ivry (in Paris)	Cie des Lampes	Capacity 5-10% of total in Europe

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Transport

All these products are shipped by rail, chiefly to Germany. Exact routes and disposition not known.

Processes

A large amount of special equipment and dies are employed in processing tungsten and molybdenum from powder to filament form. Several memos are available describing this process and indicating vulnerability.

Supply Situation

There is no indication that the supply situation is at present critical. But it is believed that tungsten and molybdenum processing and wire drawing equipment in Europe is fully employed. The high rate of electronic tube replacement in military uses of radio makes it important that the Axis sustain a high level of output.

SECRET

SYNTHETIC RUBBER

Sources

Country	Location	Firm	Remarks
Italy	Ferrara	Societa della Gomma Artificiale (50% of shares owned by Pirelli)	Capacity around 6,000 metric tons per year (4% of total Axis European capacity)
	Terni	Societa della Gomma Artificiale (50% of shares owned by Pirelli	Capacity around 6,000 metric tons per year (4% of total Axis European capacity)
	Milan	Societa della Gomma Artificiale (50% of shares owned by Pirelli)	Capacity around 1,000 metric tons per year. Also was built in 1939 as a pilot plant for the 2 mentioned above.
Poland	Oswiecim (on the Vistula in Upper Silesia)		New plant; probable capacity 25,000 tons
	Dembica	Stomil A.G.	About 7,000 tons per year capacity

Transport

The Italian and Polish output are used at least in part in the Pirelli and SPIGA tire plants in Italy and the Stomil tire plant in Poland. All shipments are by rail. Germany has been able to supplement her synthetic rubber supply by natural rubber from the Far East run through the blockade. The blockade runner usually comes into French ports on the Bay of Biscay, principally Bordeaux, from where the crude rubber is trans-shipped by rail to Germany.

SYNTHETIC RUBBER (Cont'd)

Processes

The Ferrara plant uses the Ker process, the basic raw material being alcohol produced from grapes. At Terni, the I.G. Farben Buna process is used, basic materials being coal (imported from Germany) and limestone. The Milan Factory is a pilot plant and uses both methods. Oswiecim employs the Buna process while Ker rubber is produced at Dembica from potato alcohol.

Supply Situation

Germany's rubber supply situation at the present time is tight chiefly because of two factors: (a) the bombing of the plant in Huls, Germany (the second largest plant in all of Europe), (b) the very successful tightening up of the blockade on the part of the British which has prevented any substantial imports of natural rubber for many months.

TUNGSTEN SECRET

Sources

Country	Location	Firm	Remarks
Spain	Silleda) Lalin) Noya) Area of) Sierra de) Montes)	(In native hands)	These are the most important Spanish mines. There are also scores of very small mines worked by individual peasants in the northwestern or Galician area of Spain, but they are too small to be listed. The Spanish mines together with those in Portugal are the only European source of tungsten for the Axis. Some ore may be run through the blockade from South America and the Far East, but the amount is unknown.
Portugal	Cerva) Braganca) Villa Real)	(In native hands)	These are the most important Portuguese mines. The general tungsten area is north and east of Oporto -- a continuation of the Spanish fields. As with Spain, many other small mines are to be found in the area of these large mines, but they are too small to be listed.

Transport

Of the several possible routes over which it could be sent, ore from Spain and Portugal is likely to be taken:

(a) by rail all the way to Germany --
via Ponferrada, Burgos, and Irun from Spain;
via Zamora, Valladolid, Burgos, and Irun from Portugal.

(b) by rail or truck from the mine fields in both countries to Bilbao, whence it is shipped by water to Bordeaux.

Transport (Cont'd)

Water routes from Vigo and Oporto were used in pre-war days, but are now likely to be too dangerous.

The destination of the ore has usually been the Krupp and Roechling works at Essen and the Deutsche Edelstahlwerke at Reutte in Austria.

Processes

Tungsten ores are usually of such low grade that they are subjected to a process of concentration at the mines to reduce the bulk which must be transported. After previous chemical treatment, the oxide of the ore is reduced to metal tungsten in a special furnace in which it is mixed with carbonaceous material. The process takes about four hours.

Supply Situation

Available supplies are very short of requirements. It is estimated that in 1943, the deficit will have been met in part by increased production in Portugal and Spain, by blockade running from the Far East, and from conservation measures. If Allied pre-emptive buying in Spain and Portugal can be increased in 1944, and the blockade tightened at the same time, German prospects in the tungsten field are dark.